would describe the same curves as they do now. The appearances presented to observers would be the same, and independent of the dimensions assumed. Hence the only facts we are able to appreciate are ratios. In opposition to this theorem, M. Delbœuf shows that if a system consisting of the sun and earth were to be diminished in linear dimensions to one-half, all densities remaining the same at homologous points, and the orbital velocity of the earth were reduced to one-half its value, there would be certain changes in the relations of an observer to his surroundings which could not escape notice. The velocity of sound propagation would be the same as before, but the distance traversed during a certain number of vibrations will appear larger," &c. (p. 406 of NATURE).

Here it seems to be overlooked that according to the above system of reduction of scale, the molecules of air which propagate sound would have to be conceived as diminished in size correspondingly with the planets, earth, &c., for if not, obviously the constancy of ratio of relative dimensions supposed by Laplace could not persist under this reducing process. For, considering "all the bodies in the universe," we cannot regard the linear dimensions of the earth and larger bodies as reduced to one-half, and neglect the smaller bodies (molecules). If then the dimensions of the molecules of air, and also their normal velocities be supposed reduced to one-half, then (according to what is set forth in a paper of mine in the *Philosophical Magazine*,[1] June 1877, relating to sound), the velocity of sound would be exactly halved, and therefore not remain "the same as before," as M. Delbœuf supposes. But the velocity of sound would *appear* the same as before to us with our halved standards of length on the reduced planet, in accord with what Laplace states. For as indicated in the above paper (*Phil. Mag.*), "The velocity of propagation of a wave—such as a wave of sound—in a gas is solely determined by, and proportional to, the velocity of the molecules of the gas; and the velocity of propagation of the wave is not affected by density, pressure, or by the specific gravity of a gas, or by anything else excepting the velocity of its molecules" (p. 452.)

For, on the Kinetic theory, the molecules of a gas can evidently only act upon each other by direct impact, and they therefore propagate any wave at their encounters at a rate proportional to that at which the molecules are moving in the normal state of the gas. If, we imagine then, the velocities of the smaller bodies (such as the molecules of air) to be halved, just as those of the planets, &c., are supposed halved, then the velocity of sound will be necessarily reduced to one-half, as we have seen.

Hence the above argument based on the Kinetic theory of gases would apparently support Laplace's view; and so the velocity of sound would seem to us precisely the same as before. The distance traversed during a certain number of vibrations would not then (as M. Delbœuf thinks) appear larger; all his conclusions seem to me invalidated by his assumed *unsymmetrical* selective diminution of sizes. Of course one-half the present metre would on the reduced earth be still called a "metre," because it would be a ten-millionth of the earth's quadrant, as now. A man a metre high would still be a metre high in the planet of reduced size, and the metre standard he grasped would still be the same length as himself. So it appears that if the universe known to us were suddenly halved in size by reducing the linear dimensions and velocities of all the bodies to that extent, there would be nothing to allow the change to be detected. This would also seem to harmonise with the Spencerian doctrine of the Relativity of all knowledge.

Hamburg, September 4. S. Tolver Preston.

EARLY ASTERISMS.[2]

II.

As in Egypt so in Babylonia, for the first references to the constellations we must study the religion and the mythology; Jensen shows that the first notions of the Babylonian constellations are to be got by studying the sun-gods, and especially the mythic war between the later sun-god Marduk and the monster Tiāmat.

So far as I have been able to gather, any myth like the Egyptian myth of Horus involving combats between the sun and circumpolar star-gods is entirely lacking in Babylonia, but a similar myth in relation to some of the ecliptic constellations is among the best known.

In my references to the myth of Horus I have shown that in all probability an astronomical meaning is that the rising sun puts out the northern stars; and there is evidence that we have a reference also to a sun-worshipping race abolishing the cult of Set representing the northern stars. I have also shown that temples built to northern stars have had their axes blocked to prevent the worship, and that the northern temples at On and Denderah were among the first founded for the worship of the Divine dynasty of Set or Anubis.

This being so, it is of importance to discuss the Babylonian myth of the battle between Marduk and Tiāmat from the astronomical point of view, but before we do this it will be well to see if one can trace the history of the sun-god of Eridu, which city is universally conceded to have been the original centre of Babylonian ideas until the descent of the Northmen, and to have been founded by a colony from some other country.

The Sun-god of Eridu.

Let us assume that the earliest sun-god traced at Eridu was the sun-god of those early argonauts who founded the colony.

We are told that this sun-god was the son of Ía and Dam-kina, his wife symbolising the earth, and that his name was Tammuz (Sayce, p. 144).[1]

This Ía was such a great god that to him was assigned the function of Maker of Men; he was also a great potter and art workman (p. 293), a point I shall return to presently. He eventually formed a triad with Anu and Bīl, that is, the poles of the heavens and the equator. This Tammuz (Dumazi) was afterwards identified with Nin-Girsu, and ultimately became "the Nergal of Southern Chaldæa, the sun-god of winter and night, who rules, like Rhadamanthos, in the lower world" (Sayce, p. 245), and as lord of Hades he was made son of Mul-lil (Sayce, p. 197).

This was at first. But what do we find afterwards?

Nergal is changed into the Midsummer Sun! (Jensen, p. 484). And finally he is changed into the Spring Sun Mardukat Babylon (Sayce, p. 144) where he is recognised as the son of Ía and Duazag, that is the Eastern Mountain (Jensen, p. 237).

Now however difficult it may be to follow these changes from the religious point of view, from the astronomical side the changes are not only easily explained, but might have been predicted, provided one hypothesis be permitted, namely, that the colony who founded Eridu were originally inhabitants of some country south of the equator.

Such an hypothesis may at first sight appear strange, but the view that Eridu was colonised from Cush has been supported by no less an authority than Lepsius.[2]

Now the boundaries of Cush are not defined, but they may possibly include the Land of Punt from which certainly part of the Egyptian culture was derived.

Punt was always considered a "Holy Land," and it was acknowledged that several of the Egyptian gods had been thence introduced. Hathor was "Queen of the Holy Land," "Mistress and Ruler of Punt." Amen Ra was "Hak" or "King" of Punt, and Horus was the Holy Morning Star which rose to the west (?) of the land of Punt.[3]

Maspero refers to an ancient tradition that the land of Punt could be reached by going up the Nile, where eventually an unknown sea was reached which bathed the land of Punt. Was this one of the great lakes?[1]

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[1] "Mode of the Propagation of Sound and the Physical Conditions which determine its Velocity on the Basis of the Kinetic Theory of Gases."

[2] Continued from p. 440.

[1] It would seem also that Isara = Tammuz. This connects the myths of Isis and Osiris, Tammuz and Adonis, and the cult at Byblos (see Sayce p. 228).

[2] Introduction to Nubische Grammatik, 1880.

[3] Rawlinson, ii. 134.

Brugsch[2] is of opinion that Punt occupied the south and west coasts of Arabia Felix, but Maspero and Mariette do not agree with him. The two latter authorities identify it with that part of the Somali land which borders on the Gulf of Aden. It is the Cinnamonifera regio or Aromatifera regio of the ancients.[3]

The inscriptions at Dêr el-Bahari make it quite certain that Punt is in Africa. Hottentot Venuses and elephants, to say nothing of the general products of the country referred to as among the freight of the ships on their homeward voyage, distinctly point to Africa, and I think a southern part of it.

The first organised expedition to Punt of which we hear anything is that organised by Se-ānχ-ka-Rā, the last king of the 11th *Theban* dynasty. This was a new traffic by way of the Red Sea. There was then no canal joining the sea with the Nile in existence; the expedition went by land to Coptos.[4]

They further indicate, as Maspero suggests, that the expedition of Hātshepset anchored up a river, and not on the sea-shore, especially since the native huts are shown as built on piles. This again makes Africa much more probable than Arabia.

If we agree that Punt is really in Africa south of Somali-land, there is a great probability that the tradition referred to by Maspero is a true one.

There is distinct evidence that Horus, Hathor, and Amen-Rā are worships coming from the south and dealing with southern stars exclusively. With regard to Horus, it is necessary to discriminate, since there were two distinct gods—Horus in N. and S. Egypt, *and Horus of the south was the elder of the two.* The Hawk God of Edfû, Harhouditi, the southern Horus, had for servants a number of individuals called Masniou or Masnitiou = blacksmiths. The Hawk God of the Delta, the northern Horus, Harsiisit, has for his entourage the Shosou Horou.

Now Maspero has recently pointed out[5] that the southern Horus may have been imported, not from Arabia Felix or Somali-land, but from Central Africa!

Among all early peoples the most important times of the year must necessarily have been those connected with seed time and harvest at each locality. Now the spring equinox and summer solstice south of the equator are represented by the autumnal equinox and the winter solstice to the north of it. If the colonists who came to Eridu came from a region south of the equator, they would naturally have brought not only their southern stars, but their southern seasons with them; but their springtime was the northern autumn, their summer solstice the northern winter. This could have gone on for a time, and we see that their great sun-god was the god of the winter solstice. Tammuz = Nergal.

But it could only have gone on for a time, the climatic facts were against such an unnatural system, and the old condition could have been brought back by calling the new winter summer, or in other words making the winter god into the summer sun-god, in short, changing Nergal into a midsummer sun-god. This it seems they did.

But why the further change from Nergal to Marduk? Because the northern races were always tending southwards, being pushed from behind, while the supply of Eridu culture was not being replenished. The religion and astronomy of the north were continually being strengthened, and among this astronomy was the cult of the sun at the vernal equinox, the springtime of the northern hemisphere, sacred to Marduk. Nergal, therefore, makes another stage onward and is changed into Marduk!

It is also interesting to find that in Ninib, another sun god, we have almost the exact counterpart of the Egyptian Horus. He is the eastern morning sun, the son of Ísara (? Osiris), and the god of agriculture.[1]

I append one out of many published hymns to the Sun God:—

O Sun (god)! on the horizon of heaven thou dawnest,
The bolt of the pure heaven thou openest,
The door of heaven thou openest.
O Sun (god)! thou liftest up thy head to the world;
O Sun (god)! thou coverest the earth with the majestic brightness of heaven.

Marduk then, the son of Ea, was finally as definite a spring equinox sun-god as Amen Rā in Egyptian mythology was a summer solstice sun-god.

Marduk was more than this, he represented the constellation of the Bull. Here I quote Jensen (p. 315).

"It has already been suggested that the Bull is a symbol of the Spring-Sun *Marduk;* that he was originally complete; that he at one time extended as far as the Fish of *Ía*, *i.e.* the western Fish; that the Fish of *Ía*, out of which the sun emerged at the end of the year in ancient times to enter Taurus, is to represent *Ía*, the God of the Ocean, out of which his son *Marduk*, the early sun, rises daily; finally, that a series of constellations west of the Fish(es) is intended to represent symbolically this same ocean. *Marduk* is on the one hand, as early sun of the day (and the year), the son of *Ía*, the god of the world-water."

As to the sun-god Marduk, then, he represents the sun at the vernal equinox, when the sunrise was heralded by the stars in the Bull.

But what, then, are the fish of *Ía* and the other constellations referred to? They are all revealed to us by the myth. They are the southern ecliptic constellations. We gather this from Jensen's account of the fight that Marduk—this Egyptian Horus—has with certain monsters inhabiting the world-ocean. The monsters being called generically Tiāmat.

Tiāmat.

Tiāmat, according to Jensen, means initially the Eastern Sea (p. 307). This was expanded to mean the "Weltwasser" (p. 315), which may be taken to mean, I suppose, the origin of the Greek ὠκεανὸς, and possibly the overlying firmament of waters.

These firmamental waters contain the southerly ecliptic constellations, the winter and bad-weather signs—the Scorpion, the Goat-fish, and the Fish among them.

It must be pointed out that these southerly constellations were associated with the winter solstice Sun-God of Eridu *in his first stage.*

The Myth of Marduk and Tiāmat.

But this Horus no longer smites the hippopotamus, that is the northern stars, his quarry is elsewhere; he does battle against this world-ocean in the form of Tiāmat and among the allies of Tiāmat we find a Scorpion-Man (p. 277), a Goat-Fish, and a Fish-Man, and to the west of the vernal equinox, *i.e.* in the 'water-region' of the Heavens, a Fish (Fish of *Ía*), a goat-fish and a scorpion.

We are evidently dealing here with Scorpio, Capricornus and Pisces, the ecliptic constellation of the winter months. Marduk against Tiāmat was the never-ending battle of May against December.

Imprimis then we have the later developed northern spring sun destroying the evil gods or spirits of winter, and chief among them, of course, the goat-fish, which, from its central position, would represent the winter solstice.

But this goat-fish was Ía of Iridu. The primal god of

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[1] Maspero, "Histoire Anc.," p. 5.

[2] Brugsch, "History of Egypt," 1891, p, 54.

[3] Mariette, "Der el-Bahari," p. 31.

Rawlinson, ii. 131.

[5] "L'Antropologie," 189-, No. 4.

[1] Jensen, p. 195, 192.

Babylonia! This Jensen, by his wonderful analysis (would that I could completely follow it in its marvellous philological twistings, pp. 73-81) puts beyond question, and clinches the argument by showing that our "tropic of Capricorn" of to-day, the goat still represented on our globes of to-day with a fish's tail! was called by the Babylonians "the path followed by Ía" or in relation to Ía.

The myth, then, has to do with the fact that the winter sun worship of Eridu was conquered by the spring sun worship of the north.

If we accept this we can compare the Egyptian and Babylonian myths from the astronomical point of view in the following manner, and a wonderful difference in the astronomical observations made as well as in the form, though not in the basis, of astronomical mythology in Egypt and Babylonia is before our eyes.

Astronomically in both countries we are dealing with the dawn preceding sunrise on new year's day, and the accompanying extinction of the stars.

But which stars? In Egypt there is no question that the stars thus fading were thought of as being chiefly represented by the stars which never set, that is the circumpolar ones, and among them the Hippopotamus chiefly.

The southern cult had conquered the northern one, the southern Horus had conquered Set.

We now learn that in Babylonia the chief change had been in the sun-god. Here the northern cult had conquered. The exotic worship of the winter constellations had been abolished, and they were pictured as destroyed under the form of Tiāmat,[1] although they were once as prominent as Set in Egypt.

Now I believe that it is generally recognised that Marduk was relatively a late intruder into the Babylonian pantheon. If he were a god brought from the north by a conquering race (whether conquering by craft or kraft does not matter), and his worship replaced that of Ia, have we not *mutatis mutandis* the exact counterpart of the Egyptian myth of Horus? In the one case we have a southern sun-worshipping race ousting north-star worshippers, in the other a northern equinoctial sun-worshipping race ousting the cult of the winter solstitial sun. In the one case we have Horus, the rising sun of every day slaying the Hippopotamus (that is the modern Draco) the regent of night; in the other Marduk, the Spring sun-god slaying the animals of Tiāmat, that is apparently the origins of the Scorpion, Capricornus, and Pisces, the constellations of the winter months which formed a belt across the sky from east to west at the vernal equinox.

J. NORMAN LOCKYER.

(*To be continued.*)

THE BRITISH ASSOCIATION.

NOTTINGHAM, SEPTEMBER 22.

THE bright and pleasant weather universally hoped for, but very generally unexpected, has favoured the meeting of the Association after all; it had been the one uncertain element for which the local committee could make no provision. The fine weather has made the success of the gathering complete. By midday on Monday, the 11th, the reception room was in readiness for the multifarious purposes to which it had been applied, and shortly after that time the booking clerks were kept fully employed for some hours in enrolling local members. The arrival of members was less noticeable on Tuesday, but throughout Wednesday the booking clerks, lodging and hotel clerks, the postal department, and the various excursion, garden party, and recreation counters were constantly besieged. The admirable writing-room also came largely into use, while the ladies found their way to their own special suite of elegantly furnished apartments. Later on the ladies obtained the privilege of entertaining gentlemen to afternoon tea in their capacious drawing-room, a privilege which became rapidly so popular that the accommodation was inadequate to the demand.

Following the strictly business meetings in the early part of the day, came the first general meeting in the Albert Hall, to hear the President's address. The large hall was comfortably filled with an attentive audience, the decorations consisting of little else than the long series of banners bearing the name, coat-of-arms, and year of service of each of the distinguished Presidents who has passed the chair during the sixty-two years of the Association's existence, the banner of this year's President being suspended in front of his reading-desk. The President's address, which was easily heard throughout the hall, was received with applause, the Mayor of Nottingham and the Bishop of Southwell, respectively, proposing and seconding the vote of thanks at its conclusion.

On Thursday (14th) sectional business began in earnest by the delivery of the presidential addresses in the different sections, followed by the reading of papers and reports. The workers of the Association easily found their appointed quarters, and reached them in every case in a few minutes after leaving the reception room, since all the sectional rooms were within easy distance. Five sections met in the University College itself; one in the Poor Law Offices, opposite the College; another in the Central Hall, nearly facing the college; while the geographers had only to pass from the large hall of the Mechanics' Institution (the reception room) to the lecture hall of the same institution. Each of these sectional rooms was completely fitted with all that was requisite to illustrate the papers which were communicated, the equipment ranging from the blackboard and chalk only, to the supply of dark blinds, and lantern supplemented by large diagram frames, electric current, gas, water, compressed gases, and the many other requisites for the experimental sciences. Bearing in mind the difficulty which hard-working members have found at previous meetings in staving off starvation at the luncheon hour, a large luncheon buffet had been provided in the University College; this was accessible to all members, and entailed only a few minutes' absence for luncheon from the business of any section. In the afternoon, Sir John Turner, a local vice-president of the Association, entertained a large party of visitors, with their hosts, in his beautiful grounds at Mapperley; and in the evening the Mayor received the members in the Castle Museum building, where the extensive galleries had been hung with a specially selected series of pictures, and music and refreshments were provided.

Friday (15th) was perhaps specially noticeable for the brilliant demonstration given in Section B by Dr. Meslans, assistant to M. Moissan. The section was crowded, and the audience included a considerable number of the leading British chemists. Dr. Meslans, who had carefully rehearsed his experiments in the laboratory on the previous day, proceeded to prepare gaseous fluorine, and amidst the greatest enthusiasm, both of the experimenter and of his audience, sulphur, phosphorus, silicon, and charcoal were ignited in the stream of the element. Several chemists who entered the room sceptical of the true isolation having been effected, rose and gave their entire assent, and at the suggestion of Sir Henry Roscoe, the President, immediately dispatched a congratulatory telegram to M. Moissan, who had been detained in Paris by indisposition. In the afternoon one party of members

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[1] There seems to be no question that Sit, Tiāmat, and the "Great Dragon" of the Apocalypse, represent the same idea. See Sayce, p. 102.